CONFIDENTIAL ATTORNEY WORK PRODUCT

HYDROLOGIC EVALUATION OF JULY 17, 2010 FLOODING IN THE HARLESS CREEK WATERSHED PIKE COUNTY, KENTUCKY

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EXECUTIVE SUMMARY

In August 2010, Faulkner & Flynn, Inc. (F2) was retained by Pillersdorf, DeRossett & Lane (PD&L) to evaluate the effect of surface mining within the Harless Creek Watershed on peak stormwater runoff and flooding of Harless Creek. On July 17, 2010, Harless Creek experienced a catastrophic flood that severely damaged or destroyed a significant number of homes and outbuildings within the Harless Creek Watershed. The location of the Harless Creek Watershed is shown on **Figure 1**. The permitted surface mining operations located within the Harless Creek Watershed are listed in **Table 1** and shown in **Figure 2**. F2 prepared representative hydrologic and hydraulic models of the Harless Creek Watershed for the period prior to surface mining (pre-mining land use condition) and at the time of the July 17, 2010 flooding (current mining land use condition). These models were used to evaluate how the surface mining operations of Cambrian Coal Corporation and AEP Kentucky Coal, LLC affected the hydrologic balance and flooding within the Harless Creek Watershed.

TABLE 1
Permitted Surface Mining Operations
Harless Creek Watershed
Pike County, Kentucky

Permit No.	Mine Permittee	Mine Permit Status
898-0660	AEP Kentucky Coal, LLC	Permit released
898-0649	AEP Kentucky Coal, LLC	Phase I release
898-0618	Cambrian Coal Corporation	Active, currently being mined
898-0619	Cambrian Coal Corporation	Active, currently being mined
898-0819	Cambrian Coal Corporation	Active, currently being mined

F2 used the HEC-HMS modeling software (HEC-HMS) to construct representative hydrologic models of pre-mining and current mining land surface conditions within the Harless Creek Watershed.[7] The current mining hydrologic models incorporated the changes in land surface conditions due to surface mining related activities such as topsoil removal, mass excavation and grading, and construction of valley fills and haul roads. The difference in the peak stormwater runoff flows is attributed to the surface mining operational methods used by Cambrian Coal Corporation and AEP Kentucky Coal, LLC. The Harless Creek Hydrologic Model was used t

compute the peak stormwater runoff for the pre-mining and current mining land uses for the conditions listed below.

- The peak stormwater runoff for the pte-mining and current mining land use conditions was determined using the July 17, 2010 rainfall data for the Harless Creek Watershed (July 17, 2010 model storm) as well as the standard 24-hour 1 year (100% annual probability (chance)), 2 year (50%), 5 year (20%), 10 year (10%), 25 year (4%), 50 year (2%) and 100 year (1%) average recurrence interval storms (standard recurrence interval storms). This hydrologic evaluation assessed the probable cumulative hydrologic impacts of all mining activities within the Harless Creek Watershed and addressed elements of the cumulative hydrologic impact assessment (CHIA) process, as set forth in 30 CFR 780.21(g) and 405 KAR 8:30.32.3(b).
- The effect of the permitted surface coal mining operations on peak stormwater runoff for representative sub-watershed areas was quantified. The determination of the impact of surface coal mining operational methods on flooding is required as part of a probable hydrologic consequences determination (PHCD) as set forth in 30 CFR 780.21(f) and 405 KAR 8:30.32.3.
- The peak stormwater runoff for the standard recurrence interval storms was evaluated to determine how the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations affected the frequency and intensity of flooding in the Harless Creek Watershed.
- The Harless Creek hydrologic model was used to determine if the sedimentation ponds located in Permit Area No. 898-0619 were adequately designed, constructed and maintained to attenuate peak runoff flows generated during the July 17, 2010 model storm and the standard 10-year recurrence interval storm.

The Harless Creek hydraulic model was constructed using the HEC-RAS modeling software (HEC-RAS) and used to determine how the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations affected the water depths and flow velocities within Harless Creek and adjoining overbank areas.[8] The Harless Creek hydraulic model results and guidance published by the United States Department of Interior Bureau of Reclamation (US Bureau of Reclamation), were

used to determine how the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations affected flood flow hazards during the July 17, 2010 flood.

The following conclusions have been reached based on this hydrologic study of the Harless Creek Watershed:

1. The change in land cover conditions resulting from the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations and failure to properly reclaim mined areas resulted in a 44% increase in peak stormwater runoff during the July 17, 2010 model storm. The peak stormwater runoff increased from 3,020 cubic feet per second (cfs) to 4,360 cfs for the current mining condition. The peak runoff generated within seven representative sub-watershed areas was significantly increased during the current mining condition for the July 17, 2010 model storm and the standard recurrence interval storms. These increased peak flows are the direct result of the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations and the failure to properly reclaim surface mined areas. The increased peak stormwater runoff flows exacerbated flooding and significantly increased the destructive force of the flood water during the July 17, 2010 flood.
2. The AEP Kentucky Coal, LLC and Cambrian Coal Corporation surface mining activities and the failure to properly reclaim mined areas increased the intensity and frequency of flooding within the Harless Creek Watershed. The specific increase for each flood recurrence interval storm is as follows:
    - The flooding risk for the 2 year storm (50% annual probability (chance)) increased by more than 200% during the current mining period. Areas within the pre-mining 2 year floodplain are now at risk of flooding more than once a year.
    - The flooding risk for the 5 year storm (20% annual probability (chance)) increased 450% during the current mining period. Areas within the pre-mining 5 year floodplain are now at risk of flooding every 1.1 years (91% annual probability (chance)).
    - The flooding risk for the 10 year storm (10% annual probability (chance)) increased 450% during the current mining period. Areas within the pre-mining 10 year

floodplain are now at risk of flooding every 2.2 years (45% annual probability (chance)).

- The flooding risk for the 25 year storm (4% annual probability (chance)) increased 470% during the current mining period. Areas within the pre-mining 25 year floodplain are now at risk of flooding every 5.4 years (19% annual probability (chance)).
- The flooding risk for the 50 year storm (2% annual probability (chance)) increased 470% during the current mining period. Areas within the pre-mining 50 year floodplain are now at risk of flooding every 11.2 years (9% annual probability (chance)).
- The flooding risk for the 100 year storm (1% annual probability (chance)) increased 460% during the current mining period. Areas within the pre-mining 100 year floodplain are now at risk of flooding every 21.7 years (5% annual probability (chance)).
- The likelihood of severe floods causing property damage and the potential loss of life has increased significantly as a direct result of the failure of Cambrian Coal Corporation and AEP Kentucky Coal, LLC to properly reclaim surface mined areas. Catastrophic flooding similar to the magnitude experienced on July 17, 2010 can now be expected to occur repeatedly during the typical lifespan a resident living within the Harless Creek Watershed.

3. The representative sedimentation ponds located on Cambrian Coal Corporation Permit Area 898-0619 were not properly designed, constructed and maintained to reduce peak stormwater flows during the July 17, 2010 model storm and the 10-year (10%) average recurrence interval storm. These data confirm that the sedimentation ponds located on Cambrian Coal Corporation Permit Area 898-0619 were inadequate to significantly reduce peak stormwater flows and did not protect against downstream flooding during the July 17, 2010 storm.
4. The change in land cover conditions associated with the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations and failure to properly reclaim mined areas significantly increased the water depth and flow velocities within Harless Creek during

the July 17, 2010 model storm. The average flow depth increased approximately 1.25 feet (ft) while the flow velocities in the left and right overbank areas increased approximately 54 percent (%) and 31%, respectively. The increased water depths and velocities expanded the high danger zone for the left and right overbank areas by 286% and 156%, respectively. The high danger zones are areas where lives were in jeopardy due the combined flow depth and velocity conditions.[15] The increased flow depth and velocities exacerbated flooding within the Harless Creek Watershed, placed lives in jeopardy and significantly increased the destructive energy of the July 17, 2010 flood waters.

1.0 SUMMARY OF DATA RELIED UPON

The following data was relied upon to develop the conclusions stated in this report.

1.1 SITE INSPECTIONS

F2 inspected the Harless Creek Watershed on August 11, 2010 and January 19, 2011. The inspections were attended by Mr. John Eichenberger, P.E., Mr. Jack Spadaro, Mr. Justin Shimp, P.E., and area resident Mr. Freddie Coleman. The local topography and geographic features, vegetative cover, land use conditions and mining practices within the Harless Creek Watershed were directly observed during these inspections. During the August 11, 2010 inspection, F2 completed a flyover of the permitted surface mining operations within the Harless Creek Watershed. F2 also attempted to drive up Harless Creek Road, but could not pass due to the flooding of Harless Creek caused by a 2-year recurrence interval storm. F2 returned to Harless Creek on January 19, 2011 and inspected the full length of Harless Creek from Route 460 to its confluence with Powell Hollow.

1.2 BASE MAP AND AERIAL PHOTOGRAPHY DATA

Two base site maps of the Harless Creek Watershed were prepared using numerous publicly available data sources. The pre-mining base map represented the Harless Creek Watershed prior to surface mining (pre-mining land use condition) and the current mining map represented the Harless Creek Watershed at the time of the July 17, 2010 flood (current mining land use condition). The Base Maps were geo-referenced to Kentucky State Plane Coordinates to align with field survey data and mine reclamation plan (MRP) maps for the permitted surface mines. All data included in the Base Map was manipulated using either ARCview GIS or AutoCAD software and data obtained from the following sources:

1. Pre-Mining Elevation Contour Data: Elevation contours for the pre-mining Base Map were derived from the United States Geological Survey (USGS) national elevation dataset (NED).[18] This digital terrain model (DTM) is a 30-meter grid model based on photographs from the USGS quadrangle records maps for the subject area. This model is considered to be the best available elevation data that the USGS will provide to the public.

2. Current Mining Elevation Contour Data: Elevation data and contours for the current mining conditions were derived from Intermap 5 meter resolution digital elevation models.[5] A bare earth digital terrain model (DTM) of the Harless Creek Watershed was obtained and 20 foot interval contours were created from the DTM.

3. Geographic Site Features: All roads, streams, USGS gauge stations and towns/communities were gathered from multiple sources

   - Geographic Names: All geographic names were obtained from the USGS Geographic Names Information System (GNIS).[17] This system was developed by the USGS and is the official repository of domestic geographic names data for the Federal government.
   - Stream and River Data: All stream and river data was obtained from the USGS through its National Hydrography Dataset.[16]

4. Mine Reclamation Plan Maps: Mine Reclamation Plan (MRP) maps of all permitted surface mining areas in the Harless Creek Watershed (Surface Mine Area Maps) were obtained from the Commonwealth of Kentucky, Department for Natural Resources, Division of Mine Permits.[2] The MRP maps are scanned and geo-referenced and made available for downloading via FTP. The most current MRP for each permitted area was downloaded and overlaid on the current mining Base Map using ARCview GIS.

5. Aerial Photography: A 1-meter aerial photograph taken on July 24, 2010 was obtained from the United States Department of Agriculture (USDA) National Agriculture Imagery Program (NAIP).[10] This aerial imagery is compiled in the continental United States for the purpose of making digital photography available to governmental agencies and the public. This imagery dataset has been projected into Kentucky Single Zone, NAD 83, US Survey Feet, FIPS 1600. The aerial photography was then exported from ARCview GIS into AutoCAD as a high resolution TIFF image for use with both the pre-mining and current mining Base Maps.

1.3 *RAINFALL RECORD*

Rainfall data for the Harless Creek Watershed was compiled from the following sources:

- Radar Data;
- IFLOWs; and
- National Oceanic and Atmospheric Administration (NOAA) Point Precipitation Estimates.

1.3.1 *Radar Data*

Radar Data from the National Mosaic & Q2 System was used to determine the depth of rainfall within the Harless Creek Watershed for the July 17, 2010 storm.[14] The National Mosaic & Q2 System collects data from a variety of sources including 128 WSD-88D radar sites. The Stage II Q2 (Radar Only) quantitative precipitation estimation (QPE) was used to quantify the depth of precipitation within the Harless Creek Watershed during the July 17, 2010 and August 11, 2010 storm events.

1.3.2 *IFLOWS*

Precipitation data for the former IFLOWs Station East Ridge High School (Station ID CDKK2 Latitude: 37° 20' 43.0008" Longitude: -82° 19' 59.9982"), which was located approximately 4.2 miles east of the Harless Creek Watershed, was used to develop the July 17, 2010 model storm.[13] **(Appendix 1)**

1.3.3 *NOAA Point Precipitation Estimates*

Precipitation frequency estimates for the Harless Creek Watershed were obtained from NOAA Atlas 14, Volume 2, Version 3 (NOAA Atlas 14).[1] The NOAA Atlas 14 serves as the official documentation of precipitation frequency estimates and associated information for the United States and contains precipitation frequency estimates for Kentucky. The 24-hour rainfall precipitation depths for the 2 year (50%), 5 year (20%), 10 year (10%), 25 year (4%), 50 year (2%) and 100 year (1%) average recurrence interval storms (standard recurrence interval storms) were used with the Harless Creek hydrologic model to determine peak flows for these standard recurrence interval storms. The recurrence interval is based

on the probability (chance) that the given event will be equaled or exceeded in any given year. For example, there is a 1% chance that a 100-year storm will occur in any given year.

1.4 SOIL HYDROLOGIC SOIL GROUP DATA

The distribution of the hydrologic soil groups (HSG) within the Harless Creek Watershed was determined using data provided on the Natural Resources Conservation Service (NRCS) Web Soil Survey.[11] The survey provides detailed information on the makeup, distribution and HSG classification of the various soil types within the Harless Creek Watershed. These data were used to develop runoff curve numbers for land unaffected by surface mining.

1.5 SCS RUNOFF CURVE NUMBERS

The SCS runoff curve numbers (curve numbers) for the pre-mining land use condition and unreclaimed surface mine areas were obtained from the NRCS Engineering Handbook and the SCS TR-55 Manual.[9, 12] The curve numbers for the reclaimed surface mined areas were obtained from Wagner et al.[19] All curve numbers were developed based on these references, the HSG and direct inspection of the Harless Creek Watershed.

1.6 SURVEY

The hydraulic model of Harless Creek was developed using data collected during a field survey completed by R.R. Crawford Engineering, Inc. in January, 2011. During the survey, twelve (12) cross-sections were surveyed along Harless Creek from immediately downstream of the most downstream residence up to the confluence of Harless Creek with Oney Fork. All survey data was collected in Kentucky State Plane South, NAD1983 Coordinates. The copy of the survey coordinate points is included in **Appendix 1**.

1.7 FLOOD HAZARD CLASSIFICATION

Guidance published by the U.S. Bureau of Reclamation (USBOR) was used to evaluate the hazards created by the July 17, 2010 model storm due to water depth-velocity conditions within Harless Creek overbank areas.[15] The Harless Creek Hydraulic Model was used to calculate the water depths and flow velocities along the length of the Harless Creek Study

Area. These water depth and flow velocities were compared to the BOR published depth-velocity flood danger level relationships for passenger vehicles, mobile homes and houses built on foundations to identify where high danger zones existed within the Harless Creek overbank area during July 17, 2011 model storm. A high danger zone is defined as a location where lives are in jeopardy due a combination of flow depth and velocity.

3.0 RESULTS AND OPINIONS

3.1 PEAK STORMWATER RUNOFF EVALUATION

The surface mining operations of Cambrian Coal Corporation and AEP Kentucky Coal, LLC within the Harless Creek Watershed and the failure to properly reclaim permitted surface mine areas resulted in a 44% increase in peak stormwater runoff for the Harless Creek Watershed based on the July 17, 2010 model storm. The peak stormwater runoff for the pre-mining condition was approximately 3,020 cubic feet per second (cfs) and increased to 4,360 cfs during the current mining condition. This increase in peak stormwater runoff exacerbated flooding during the July 17, 2010 storm event and significantly increased the destructive energy of the flood waters.

The peak stormwater runoff for seven sub-watershed areas increased significantly from the pre-mining to the current mining land use conditions based on the July 17, 2010 model storm and standard recurrence interval storms. The seven sub-watershed areas included Burnt Tree Hollow (Sub-watershed Area # 15, Permit Nos. 898-0660 & 898-0649), Slate Dump Hollow (Sub-watershed Area # 10, Permit No. 898-0649), Right Fork Harless Creek (Sub-watershed Area # 7, Permit No. 898-0649), SS-39 contributing area (Sub-watershed Area # 13, Permit No. 898-0919), SS-33 contributing area (Sub-watershed Area # 11, Permit No. 898-0919), Oney Fork (Sub-watershed Area # 8, Permit Nos. 898-0618 & 898-0619), and Frankie Fork (Sub-watershed Area # 5, Permit Nos. 898-0618 & 898-0619). The flows for the seven sub-watershed areas are summarized in **Table 3**. These increased peak stormwater runoff flows exacerbated flooding during the July 17, 2010 storm event and will result in more frequent and intense flooding in the Harless Creek Watershed now and in the future.

Cambrian Coal Corporation and AEP Coal Kentucky, LLC failed to properly surface min areas within the Harless Creek Watershed prior to the July 17, 2010 flood. The failure properly reclaim surface mined areas increased the runoff potential and caused significan higher peak stormwater runoff flows. This exacerbated flooding during the July 17, 20 storm event, significantly increased the flood's destructive energy and widespread dama

The failure to properly reclaim surface mined areas is corroborated by Kentucky Division of Mine Enforcement and Reclamation (DMR) records and the direct inspection of surface mining activities.

- In August 2010, the DMR cited the Cambrian Coal Corporation Permit No. 898-0619 (Non-Compliance Number 53-2478) for failing to complete contemporaneous reclamation work in six mine increments within the prescribed time period. The failure to properly reclaim these areas exposed these high runoff areas to the July 17, 2010 storm. F2 inspected Permit No. 898-0619 in August, 2010 and observed widespread erosion damage. This confirmed that the Cambrian Coal Corporation's failure to complete contemporaneous reclamation work increased the peak runoff flows from the surface mine areas which significantly increased flooding during the July 17, 2010 storm event.
- During the August 2010 inspection of the Harless Creek Watershed, F2 observed large reclaimed surface mine areas with poorly vegetated surfaces, significant erosion damage and numerous landslides. These conditions were present in both the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mines **(Table 1)**. The widespread erosion damage confirms that the Cambrian Coal Corporation and AEP Kentucky Coal, LLC failed to properly reclaim these surface mine areas which increased the runoff potential and significantly increased the peak runoff flows during July 17, 2010 storm.

The surface mining operations for Cambrian Coal Corporation and AEP Kentucky Coal, LLC have adversely affected the hydrologic balance of the Harless Creek Watershed, which increased cumulative peak stormwater runoff and exacerbated flooding during the July 17 2010 storm event. AEP Kentucky Coal, LLC and Cambrian Coal Corporation have failed t take the adequate measures necessary to protect the hydrologic balance outside the perm areas as required by 405 KAR 16:060(1)(a) and which has increased the peak stormwa flows and the likelihood of destructive flooding. This increased risk will continue into future unless the surface mines are properly reclaimed. Further surface disturbance wi the Harless Creek Watershed by the Cambrian Coal Corporation and AEP Kentucky C

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- During the August 2010 inspection of the Harless Creek Watershed, F2 observed large reclaimed surface mine areas with poorly vegetated surfaces, significant erosion damage and numerous landslides. These conditions were present in both the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mines **(Table 1)**. The widespread erosion damage confirms that the Cambrian Coal Corporation and AEP Kentucky Coal, LLC failed to properly reclaim these surface mine areas which increased the runoff potential and significantly increased the peak runoff flow during July 17, 2010 storm.

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LLC surface mining operations will adversely affect the cumulative hydrologic balance and further exacerbate these risks.

3.2 *FLOOD FREQUENCY EVALUATION*

The frequency and intensity of flooding within the Harless Creek Watershed has been exacerbated due to the surface mining operations of Cambrian Coal Corporation and AEP Kentucky Coal, LLC. The specific increases in the peak flow and flood recurrence interval storm for the standard recurrence interval storm are summarized below and in **Table 4**. These results confirm that the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations have adversely changed the hydrologic conditions for significant portions of the Harless Creek Watershed and failed to properly reclaim the surface mined areas. This has adversely affected the cumulative hydrologic balance for the Harless Creek Watershed such that flooding will occur more frequently and with greater intensity.

- The flooding risk for the 2 year storm (50% annual probability (chance)) increased by more than 200% during the current mining period. Areas within the pre-mining 2 year floodplain are now at risk of flooding more than once a year.
- The flooding risk for the 5 year storm (20% annual probability (chance)) increased 450% during the current mining period. Areas within the pre-mining 5 year floodplain are now at risk of flooding every 1.1 years (91% annual probability (chance)).
- The flooding risk for the 10 year storm (10% annual probability (chance)) increased 450% during the current mining period. Areas within the pre-mining 10 year floodplain are now at risk of flooding every 2.2 years (45% annual probability (chance)).
- The flooding risk for the 25 year storm (4% annual probability (chance)) increased 470% during the current mining period. Areas within the pre-mining 25 year floodplain are now at risk of flooding every 5.4 years (19% annual probability (chance)).

- The flooding risk for the 50 year storm (2% annual probability (chance)) increased 470% during the current mining period. Areas within the pre-mining 50 year floodplain are now at risk of flooding every 11.2 years (9% annual probability (chance)).
- The flooding risk for the 100 year storm (1% annual probability (chance)) increased 460% during the current mining period. Areas within the pre-mining 100 year floodplain are now at risk of flooding every 21.7 years (5% annual probability (chance)).

The likelihood of severe floods causing property damage and the potential loss of life has increased significantly as a direct result of the failure of Cambrian Coal Corporation and AEP Kentucky Coal, LLC to properly reclaim surface mined areas. Catastrophic flooding similar to the magnitude experienced on July 17, 2010 can now be expected to occur repeatedly during the typical lifespan of a resident living within the Harless Creek Watershed.

3.3 SEDIMENTATION POND PERFORMANCE EVALUATION

Three sedimentation ponds, SS-32, SS-33 and SS-39, are located at the base of hollow fills on the Harless Creek side of Cambrian Coal Corporation Permit Area 898-0619. One representative sedimentation pond, SS-39, was evaluated to determine its capacity to reduce peak flows from the July 17, 2011 model storm and the 10-year (10%) average recurrence interval storm. SS-39 reduced the peak stormwater flows by only approximately 12%. Therefore, SS-39 did not protect against flooding during the July 17, 2010 storm and does not meet the basic requirements of 405 KAR 16:090 Section 3.(2)(a).

In July 2010, following the July 17, 2010 flood event, the Kentucky Division of Mine Enforcement and Reclamation (DMR) cited the Cambrian Coal Corporation Permit No. 898-0619 (Non-Compliance Number 53-1556) for allowing the sediment level in SS-39 to exceed the cleanout capacity elevation as set forth in the permit plan. This failure to adequately maintain SS-39 further reduced its peak flow reduction capacity. During the January 2011 inspection, F2 noted that SS-33 was constructed with only a spillway and no culvert outlet. The lack of a culvert outlet would significantly reduce SS-33's capacity to

control peak stormwater flows. These data confirm that the sedimentation ponds located on Cambrian Coal Corporation Permit Area 898-0619 were inadequate to significantly reduce peak stormwater flows and did not protect against downstream flooding during the July 17, 2010 storm.

3.4 *HARLESS CREEK HYDRAULIC MODELING*

The accuracy of the Harless Creek Hydraulic Model was confirmed by comparing the computed water surface elevations for July 17, 2010 model storm with three known high water marks from the July 17, 2010 flood. The high water marks were located on three separate structures located within Harless Creek overbank areas that were not destroyed outright during the July 17, 2010 flooding. The elevations of the high water marks were determined based on the January, 2011 survey data **(see Section 1.6)**. Photographs of the high water mark locations are provided in **Appendix 3**. At all three locations, the computed total water depths were within 1 to 5% of the measured high water marks. These data confirm that the Harless Creek hydraulic model accurately represented flood flow conditions within Harless Creek.

The Harless Creek hydraulic model was also used to evaluate flood flows with Harless Creek during the August 11, 2010 storm. On this date F2 observed significant flows within Harless Creek and evidence of minor overtopping of Harless Creek **(Appendix 3)**. According to the Stage II radar data, the August 11, 2010 storm was a 2-year recurrence interval storm. Similarly the Harless Creek hydraulic model results for the 24-hour 2-year recurrence interval storm showed that no flooding occurred during the pre-mining condition and minor overtopping of the Harless Creek channel during the current mining land use condition. This is consistent with the results of the Flood Frequency Evaluation **(Section 3.2)** and confirms that the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations have adversely affected the cumulative hydrologic balance such that flooding of Harless Creek will occur more frequently and with greater destructive energy.

Representative cross-sections from July 17, 2010 Harless Creek hydraulic model were used to evaluate the water depth, flow velocities, and extent of the high danger zones for the right

and left overbank areas during the pre-mining and current land use conditions **(Appendix 4)**. The majority of the residences impacted by the July 17, 2010 flood were located within these overbank areas. The high danger zones were delineated based on USBOR published depth-velocity flood danger level relationships for passenger vehicles and identify locations where the combined destructive energy of the flood flow depths and velocity put lives in jeopardy.[15] The destructive energy of flood flows was also evaluated based on the USBOR depth-velocity flood danger level relationships for mobile homes and houses built on foundations. The Harless Creek hydraulic model results confirm that the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations exacerbated flooding during the July 17, 2010 model storm and significantly increased the flood's destructive energy within the Harless Creek overbank areas by significantly increasing the depth and velocity of the flood flows. In summary,

- Flow Depth: The flow depth increased by an average of 1.25 ft during the July 17, 2010 model storm due to the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations. The increased flow depths increased flood related damage during the July 17, 2010 flood by increasing the area inundated by flood waters as well as the destructive energy of the flood waters.
- Flow Velocities: The flow velocities in the overbank areas were increased during the July 17, 2010 model storm due to the Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations. The average velocity for the left and right overbank areas of Harless Creek increased by 53% and 31%, respectively during the current mining condition. This increase in flow velocity significantly increased the destructive energy of the July 17, 2010 flood and the associated flood related damages.
- High Danger Zone: The increased flow depths and velocities within the Harless Creek overbank areas significantly increased the extent of the high danger zone (locations where lives were in danger). The average width of the high danger zone for the left and right overbank areas increased 286% and 156%, respectively. The elevated flow depths and velocities created high danger conditions for houses built on foundations, mobile homes and passenger vehicles. The increased peak

stormwater runoff resulting from Cambrian Coal Corporation and AEP Kentucky Coal, LLC surface mining operations increased the high danger zone for the Harless Creek overbank areas, exposed the residents of Harless Creek to life-threatening conditions and exacerbated the destructive energy of the July 17, 2010 flood.

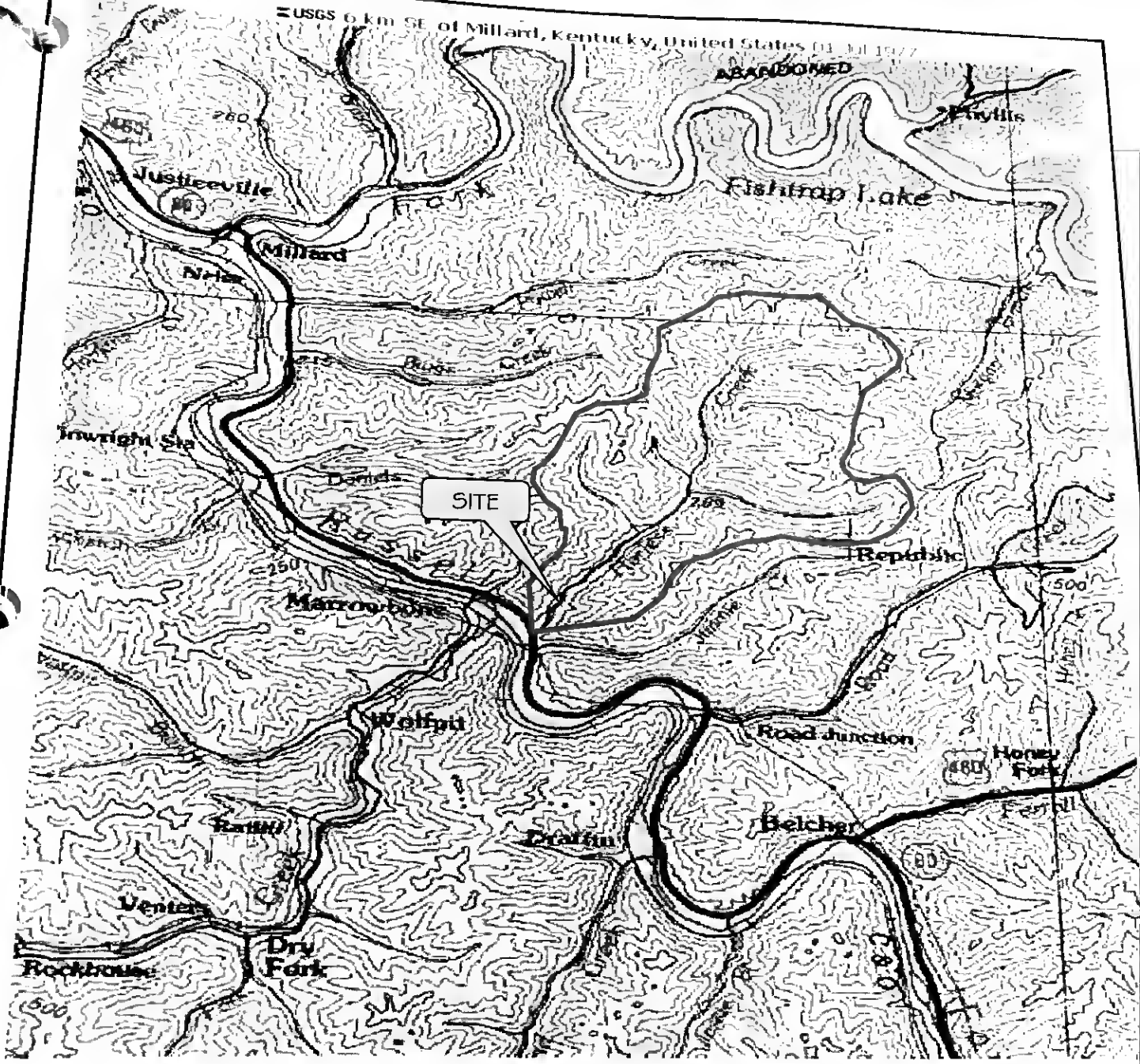

Image courtesy of the U.S. Geological Survey

Topographic map obtained from for latitudinal and longitudinal coordinates.

oject No.: PDL.612.567	FIGURE 1 SITE LOCATION MAP	FAULKNER & FLYN
wn By / Date: TFL 08/24/11		ENVIRONMENTAL MANAGEMENT CONSULT
cked By / Date: JJE 08/24/11	Harless Creek Watershed Pike County, Kentucky	
le: See above		

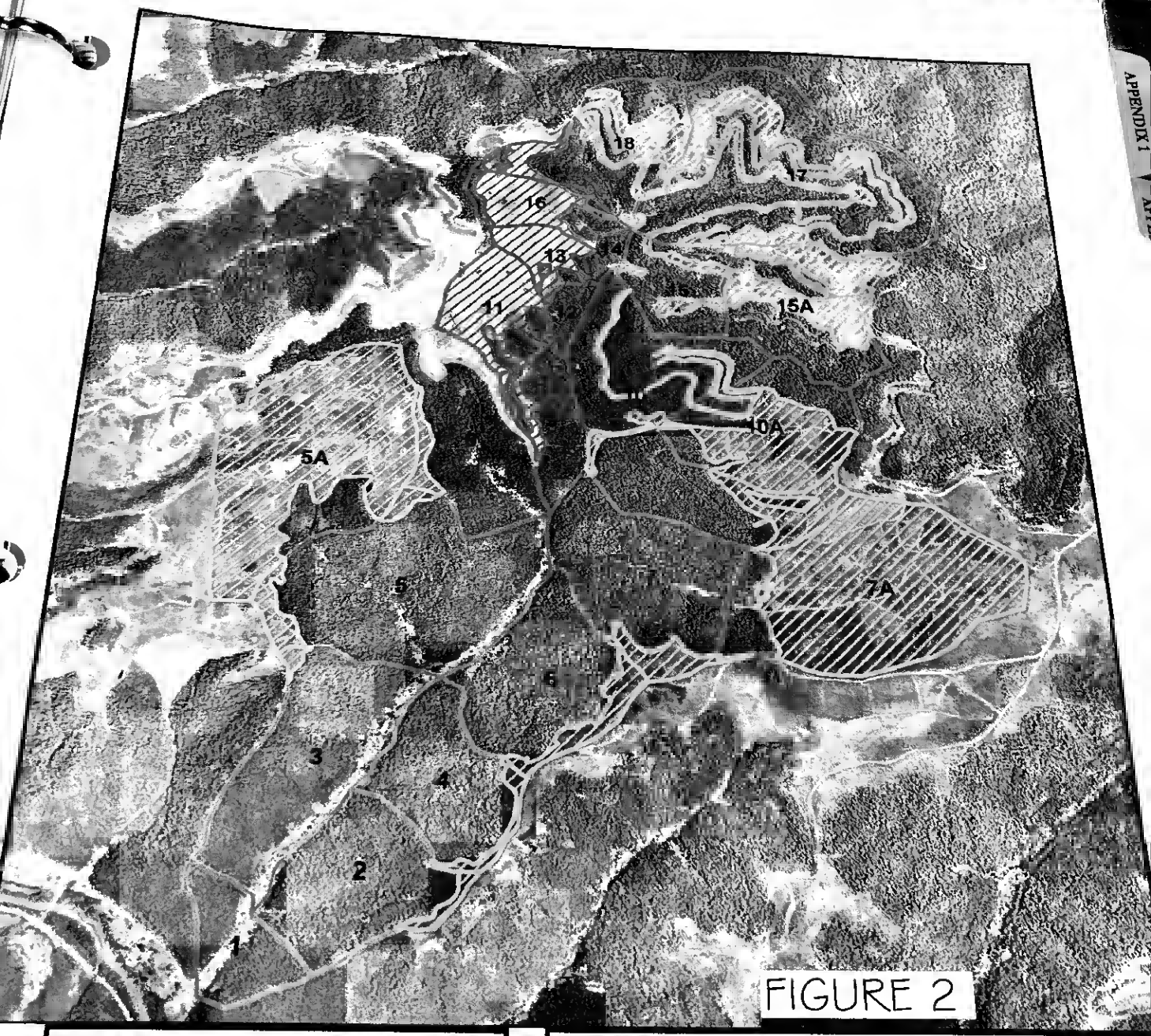

FIGURE 2

Permit # & Company

- 8980649 - AEP Kentucky Coal, LLC
- 8980660 - AEP Kentucky Coal, LLC
- 8980819 - Cambrian Coal Corporation
- 8980619 - Cambrian Coal Corporation
- 8980618 - Cambrian Coal Corporation
- Harless Creek Current Mining Watersheds

PERMITTED SURFACE MINING OPERATIONS

HARLESS CREEK WATERSHED
PIKE COUNTY, KENTUCKY

FAULKNER & FLYNN
ENVIRONMENTAL MANAGEMENT CONSULTANT

DATE 08/22/11 DRAWN BY HE

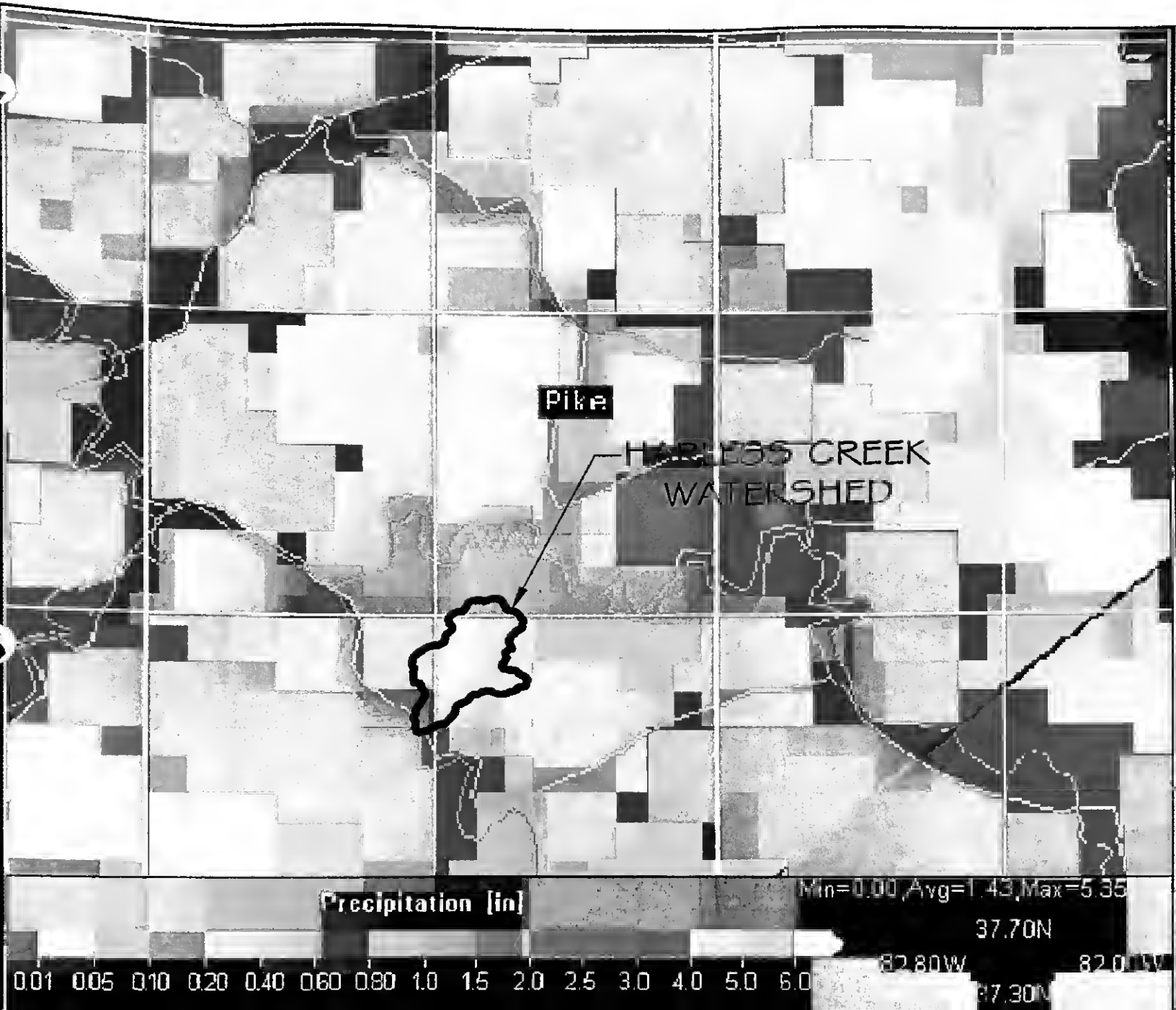
Pike
HARLESS CREEK
WATERSHED
Precipitation [in]
Min=0.00,Avg=1.43,Max=5.35
37.70N
82.80W
82.0
37.30N
0.01 0.05 0.10 0.20 0.40 0.60 0.80 1.0 1.5 2.0 2.5 3.0 4.0 5.0 6.0

TABLE 2
Sub-Watershed Areas Characteristics for the Pre-Mining and Current Mining Land Use Conditions
Harless Creek Watershed
Pike County, Kentucky

Pre-Mining			Current Mining				
Drainage Area	Total Area (acre)	Composite Curve Number	Drainage Area	Total Area (acre)	Total Mined Area (acre)	Mining Type [a]	Composite Curve Number
1	37.71	58.5	1	36.69	0.00	-	58.5
2	87.90	63.0	2	85.26	3.50	3	63.7
3	110.01	60.1	3	114.18	2.28	3	60.5
4	76.26	60.9	4	74.93	5.47	3	62.2
5	316.32	62.7	5	180.04	13.69	3	62.0
			5A	195.68	172.23	3	83.2
6	106.62	60.6	6	105.01	14.56	3	62.8
7	332.81	61.0	7	130.50	12.15	3	63.2
			7A	198.00	177.15	3	84.2
8	112.75	62.8	8	111.89	25.46	1,3	67.7
9	48.94	57.4	9	48.94	7.63	1	62.2
10	307.76	65.2	10	200.67	37.19	2,3	66.0
			10A	105.09	60.51	2,3	73.4
11	60.83	64.9	11	60.83	50.21	1	87.6
12	17.32	56.7	12	14.91	0.00	-	56.7
13	26.53	66.1	13	29.73	22.80	1	84.1
14	11.99	57.8	14	10.19	0.00	-	57.8
15	180.80	65.8	15	61.65	11.00	2,3	66.9
			15A	118.07	59.75	3	76.4
16	48.14	67.9	16	49.17	32.88	1	84.3
17	287.14	66.2	17	284.97	74.17	2,3	71.8
18	120.22	65.4	18	120.62	46.59	1,2,3	74.4

NOTES:

[a] Mining Type

1: Active Strip Mining (CN: 93)

2: Active Contour Mining (CN:87)

3: Reclaimed Mined Areas (CN:87)

TABLE 3

Peak Runoff Flows for Representative Sub-Watershed Areas for the Pre-Mining and Current Mining Land Use Conditions During July 17, 2010 Model Storm and 2, 5, 10, 15, 50, 100-Year Recurrence Interval Storms

Harless Creek Watershed

Pike County, Kentucky

Precipitation Event	Land Use Condition	Sub-Watershed Area/Upgradient Permitted Surface Mine Area						
		Burnt Tree Hollow / 898-0649 / 898-0660	Right Fork Harless / 898-0649	Slate Dump Hollow / 898-0649	Frankie Fork / 898-0618 / 898-0619	Oney Fork / 898-0618 / 898-0619	SS-33[1] / 898-0619	SS-39[1] / 898-0619
2-year	Pre-Mining	33	21	48	29	12	11	5
2-year	Current Mining	93	261	89	315	39	111	45
Percent Increase (2-year)		186%	1171%	86%	1005%	225%	873%	878%
5-year	Pre-Mining	69	55	104	69	29	25	10
5-year	Current Mining	151	383	159	454	75	149	62
Percent Increase (5-year)		119%	598%	53%	555%	155%	492%	555%
10-year	Pre-Mining	105	94	161	113	48	39	15
10-year	Current Mining	204	491	228	581	109	180	77
Percent Increase (10-year)		93%	425%	41%	412%	127%	360%	430%
25-year	Pre-Mining	163	160	253	187	79	62	22
25-year	Current Mining	283	652	333	770	162	224	98
Percent Increase (25-year)		73%	306%	32%	311%	105%	263%	338%
50-year	Pre-Mining	217	226	339	258	109	82	29
50-year	Current Mining	353	793	429	938	211	261	115
Percent Increase (50-year)		63%	251%	27%	264%	93%	217%	294%
100-year	Pre-Mining	277	300	434	338	142	106	38
100-year	Current Mining	429	942	534	1114	263	299	134
Percent Increase (100-year)		55%	214%	23%	230%	85%	184%	256%
7/17/2010	Pre-Mining	276	365	451	386	152	100	39
7/17/2010	Current Mining	384	764	514	793	209	216	91
Percent Increase (July 17, 2010)		39%	109%	14%	105%	37%	117%	134%

TABLE 4

Change in Peak Flow and Flooding Risk from Pre-Mining and Current Mining Conditions based a 1 (100%), 2 (50%), 5 (25%) ,10 (10%), 25 (4%), 50 (2%) and 100 (1%) Year Recurrence Interval SCS 24-Hour Storm Event
Harless Creek Watershed
Pike County, Kentucky

24-Hour Recurrence Interval Storm {% Annual Probability (Chance)}	1 Year (100%)	2 years (50%)	5 years (20%)	10 years (10%)	25 years (4%)	50 years (2%)	100 years (1%)
Peak Flow (cfs) - Pre-Mining Land Use Condition	100	262	600	958	1551	2117	2752
Peak Flow (cfs) - Current Mining Land Use Condition	563	912	1510	2074	2946	3733	4590
Pre-Mining Flood Plain Based on Pre-Mining Land Use Condition (Year)	1	2	5	10	25	50	100
Flooding Frequency of Pre-Mining Floodplain Based on Current Mining Land Use Conditon (Year)	<1	<1	1.1	2.2	5.4	11.2	21.7
Increase Flooding Risk from Pre-Mining to Current Mining Land Use Condition	> 200%	> 200%	450%	450%	470%	470%	460%